BOLLER & CHIVENS

16-INCH CASSEGRAIN REFLECTOR

Built For

North Georgia College

Dahlonega, Georgia

DESCRIPTION AND INSTRUCTIONS

Serial 9961

July 1968

BOLLER & CHIVENS DIVISION
The Perkin-Elmer Corporation

South Pasadena, California

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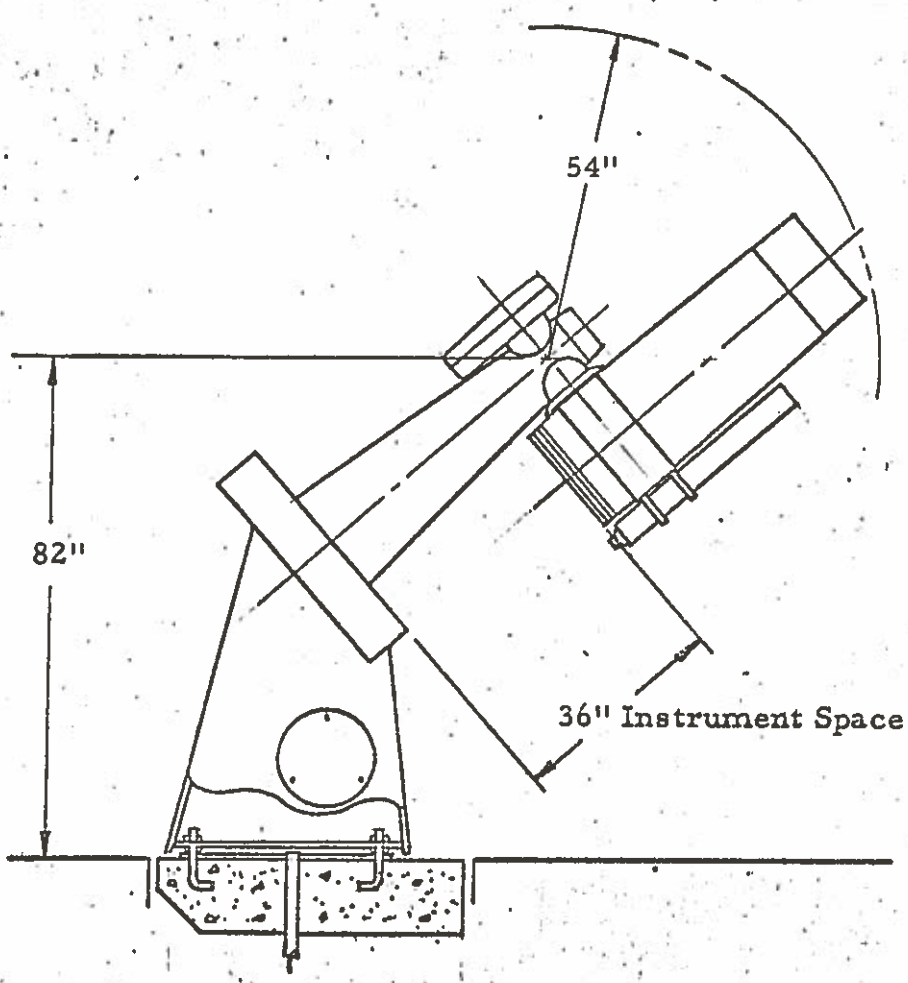
INTRODUCTION

This manual is intended to acquaint you with the details of assembly, operation, and maintenance of the Boller & Chivens 16-inch Cassegrain Reflector. The instrument combines quality design with standards of workmanship that provide the highest level of functional integrity. Information on the following pages will enable you to obtain maximum benefit from the inherent features of your telescope.

In addition, a set of assembly drawings is furnished with the instrument. Detailed drawing lists accompanying the drawings itemize each part by name and number.

We believe you will find this manual of value. We have tried to cover sufficient detail for a complete understanding of the equipment from a functional standpoint. Please feel free to call on us should additional information be needed.

CONFIGURATION



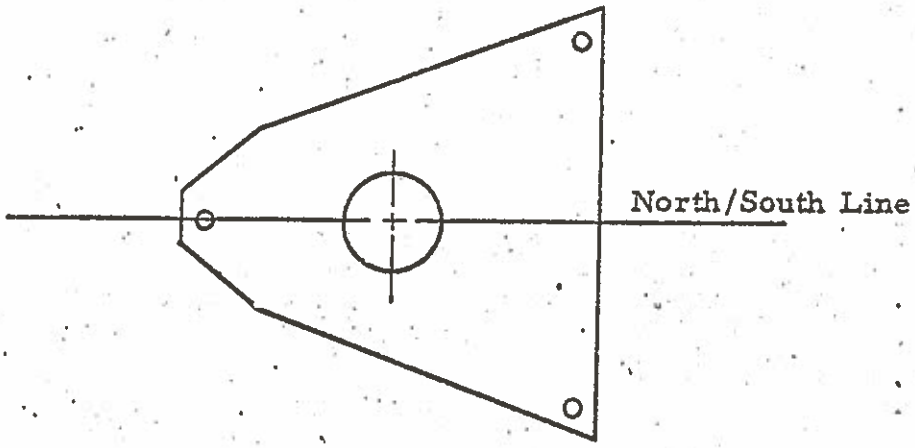
10's ft/min

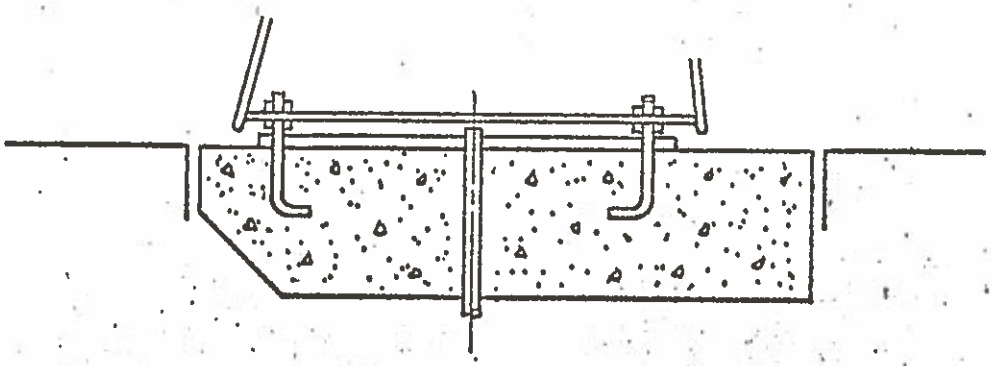
SOLE PLATE

The Sole Plate is a triangular, 3/4-inch-thick steel plate provided with three mounting studs extending upward from the top surface. One stud is located at the rear of the telescope on the north/south line, and the remaining two in the opposite corners corresponding to east and west. Each stud is supplied with two nuts, one for adjusting vertical alignment of the polar axle and one for locking the base solid.;

The studs are actually extensions of "J" bolts which protrude approximately 12-inches below the bottom surface of the plate. These "J" bolts must be securely embedded in the foundation on which the telescope is to be mounted.

An 8-inch diameter hole is provided in the center of the sole plate to allow for entrance of electrical conduit through the bottom of the telescope mounting.



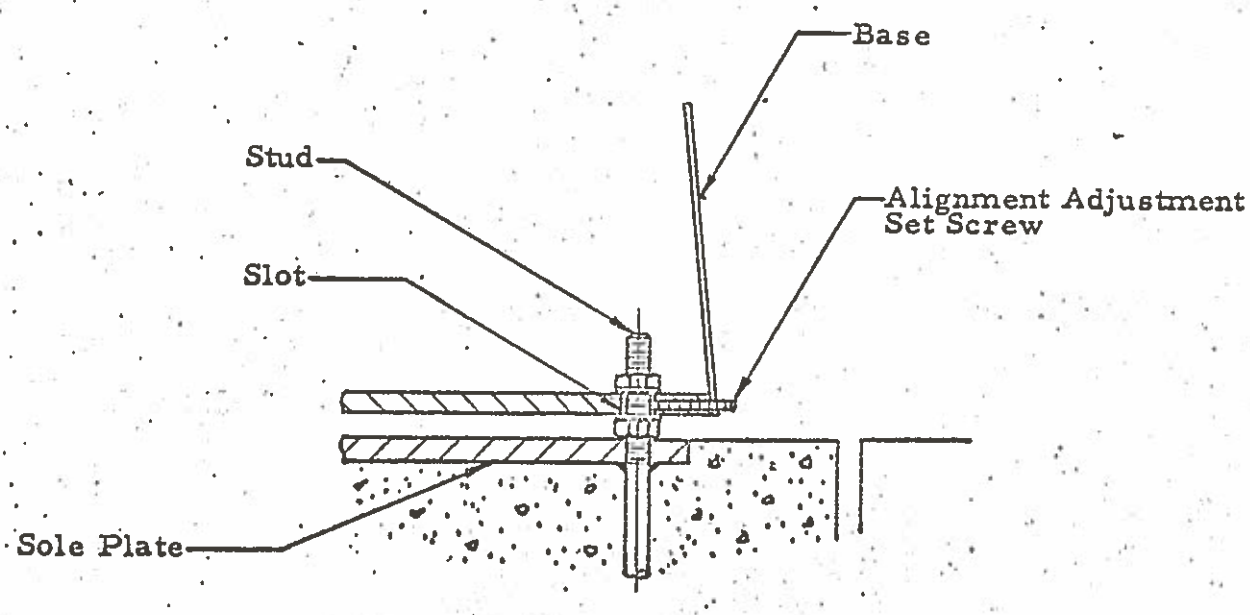


BASE

The base is a hollow, fabricated steel weldment which mounts on the sole plate providing rigid support for the telescope. Its top surface is accurately machined to the proper angle corresponding to the latitude location of installation.

In the bottom, on each side near the east and west corners, set screws are provided for precise azimuth alignment of the instrument. Slotted holes in the bottom plate of the base at these two corners accommodate the respective mounting studs. Each set screw bears against its associated stud.

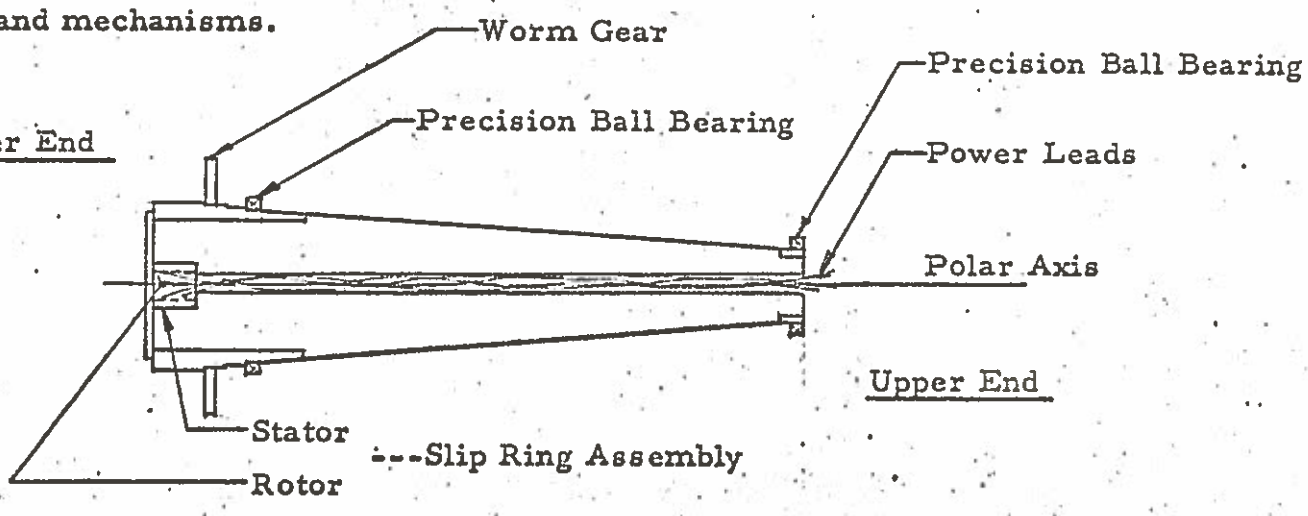
Two 16-inch diameter access holes with covers are provided in the base, one on each side. Also on one side of the base is a double-pole circuit breaker for electrical protection of the main power. Terminal strips are mounted inside the base for connection to main power leads.



POLAR AXLE SHAFT

Mounted rigidly to the base, the polar axle shaft is a conical steel weldment on which the polar axle housing rotates. It serves as a solid support for the large-diameter precision ball bearings designed for this purpose. Attached to the lower end of this shaft is a large worm gear against which the right ascension worm drives the polar axle housing.

Since the axle does not rotate and runs nearly the entire length of the polar axle housing, it makes a convenient passage for electrical power leads to the telescope. The lower end of the polar axle shaft houses the stator of the slip ring assembly to which external power is connected from the double-pole circuit breaker in the base. Five spare slip rings are provided and wired for possible future circuits, including customer-furnished stable or variable frequency power for the right ascension tracking motor. The internal rotor of the slip ring assembly is rotated by a hollow steel shaft connected at the upper end to the polar axle housing. Power leads to the telescope run from the slip ring up through the shaft. It is this feature, incorporating a special slip ring design, that avoids use of angular limiting devices so that the telescope may be rotated completely about its polar axis without fear of entanglement of internal wires and mechanisms.



POLAR AXLE HOUSING

A conical steel weldment extending upward from the base forms the polar axle housing. It rotates about the polar axle shaft which, in turn, is bolted securely to the top surface of the base.

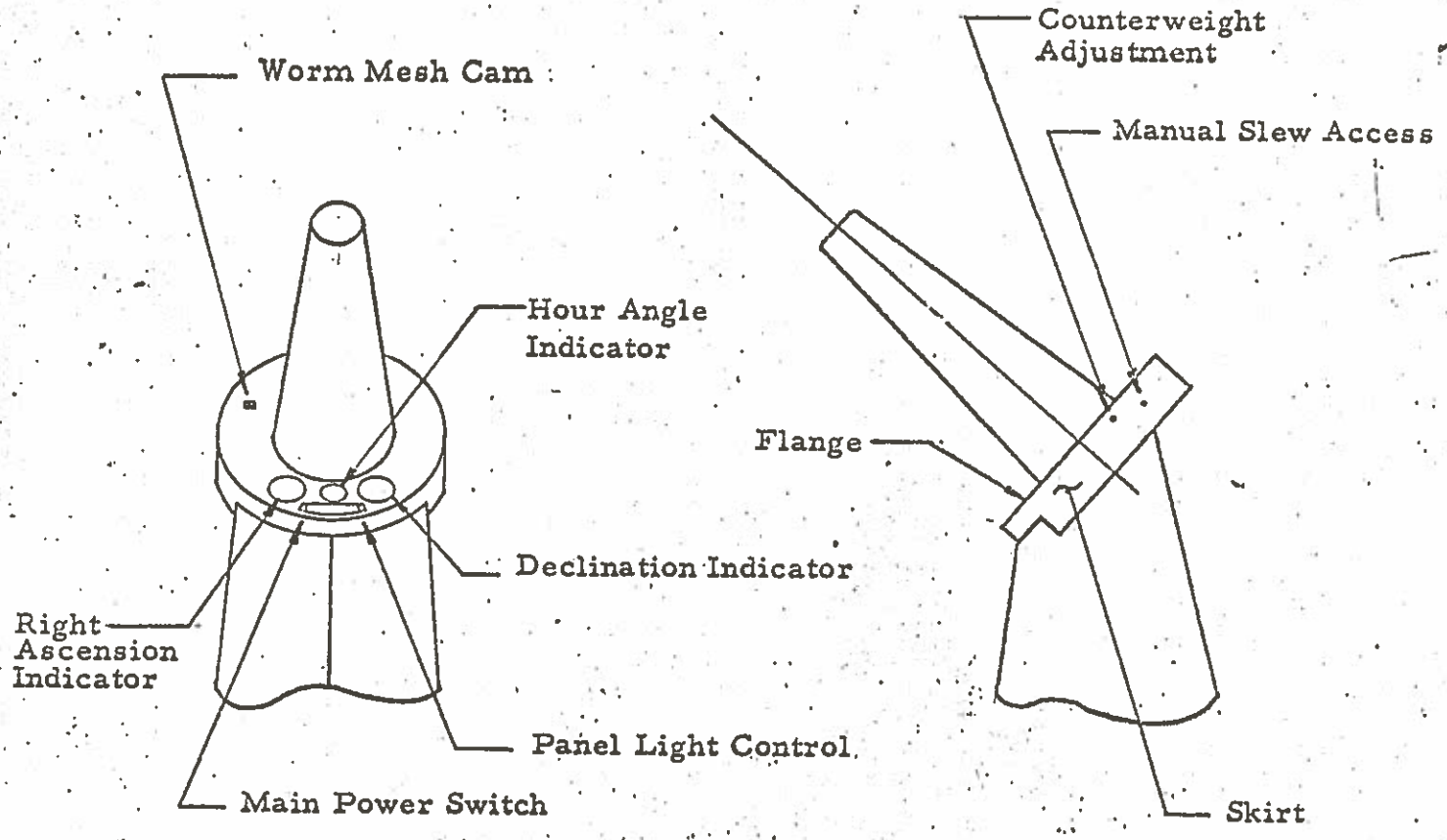
The large flange and skirt at the lower end of the housing, next to the base, contains the right ascension drive mechanism, right ascension counterweights, position indicating drives, and electrical power supply components necessary to operate the drives for the right ascension and declination. On the face of the flange are indicators for declination, right ascension, and hour angle. Also located on this surface is a key switch for main power, and a control for illumination of the indicators.

The polar axle housing and included components are supported from the polar axle shaft by two large-diameter precision ball bearings, one at each end. In the upper end of the polar axle housing are mounted two more precision ball bearings for support of the declination axle.

When balancing the telescope, the worm drive of the right ascension mechanism should be moved out of its normal mesh position with the worm gear on the polar axle. This will permit sufficient rotary freedom of the polar axle housing to determine a condition of static balance. The worm can easily be moved slightly out of mesh by turning an internal cam designed for this purpose. Access to this cam is on the face of the flange of the polar axle housing, and it can be turned with an Allen wrench. Turning the cam 180 degrees moves the worm a maximum distance from the worm gear. At the same time electrical interlocks disconnect power to the driving motors to prevent the telescope from running while in this condition, to avoid damage to gears.

Radial movement of the right ascension counterweights for balancing purposes is accomplished by means of another Allen head shaft, the end of which is located on the skirt of the flange on the polar axle housing.

Manual rotation of the polar axle housing may be done by means of a third Allen head drive. Access to this fitting is gained by removing an Allen plug just above the counterweight adjustment on the skirt of the flange. By rotating an Allen wrench engaged in the fitting, the slew motor shaft is turned, and hence the entire housing. The worm drive should be in its mesh position with the ring gear for this operation; however, care should be taken not to force the slew motor shaft in the event gearing may be jammed.



RIGHT ASCENSION DRIVE

Mounted inside the flange of the polar axle housing, the right ascension drive consists of a motor driven worm assembly. The entire assembly therefore moves as a component of the polar axle housing as it rotates. The worm drives against a 20-inch diameter stationary worm gear which is attached to the polar axle. As mentioned earlier, the worm drive assembly can be pivoted slightly away from the worm gear to allow sufficient backlash for sensing balance of the polar axle housing.

Three different motors are used to control the angular velocity of the polar axle housing, depending on the function, or speed required. Tracking speed is produced by a 115-volt AC synchronous motor, geared to produce sidereal rate output when driven by a 60 cycle per solar second power source. This motor is normally driven direct from the powerline, but an independent circuit to the terminal strip in the telescope base is provided in order that power of variable or stabilized frequency may be supplied if desired.

The guide-set motor provides power to the worm through the differential gear train, which is also driven by the tracking motor. The guide-set motor is a 115-volt AC servo motor with a 36-volt AC control winding and has a tachometer-generator attached. When this servo motor is in a stalled condition, the tracking motor alone drives the worm, but when electrical power is applied to the servo motor, its mechanical output is added to that of the tracking motor through the differential. Control power for the servo motor is provided by a servo amplifier which compares the output voltage of the tachometer-generator with the command voltage from the pushbutton control paddle. The servo amplifier is also mounted inside the large flange of the polar axle housing.

Both the tracking motor and the guide-set motor drive the worm through a magnetic clutch located between the differential and the worm. This automatically disengages when "slew" speed is commanded from the pushbutton control paddle. The 115V AC slew motor is also energized at this time and drives the opposite end of the main worm through a set of spur gears. Upon cessation of the "slew" command electrical power to the slew motor is cut off and the clutch re-engages so that the clutch acts as a brake.

In addition to the worm gear, a large diameter spur gear is also mounted on the polar axle. A 90V DC torque motor which is mounted in the polar axle housing drives against this gear. The purpose of the torque motor is to provide a constant torque between the primary worm gear and worm in a direction opposite the telescope tracking direction. This insures that the worm always drives against one side of the worm gear teeth and that there is no backlash until the preload torque of approximately 10 ft/lbs. at the axle is exceeded.

POSITION INDICATING DIALS

Located on the face of the flange on the polar axle housing are three dials. These show the attitude of the telescope in hour angle and declination, and also in right ascension. The right ascension dial is driven through a differential between a drive from the polar axle housing and a clock for sidereal time input.

Each dial may be adjusted by inserting a hex key through a hole in the center of the dial face and turning the indicating hands to their proper reading. A small rubber plug must first be removed from the hole in the dial face, and replaced after this operation to prevent dust from entering the dial assembly. The dials are back-illuminated with electric lamps, the intensity of which may be varied with a control knob located near the declination indicator. The lamps are contained in automotive type sockets which are held in place with spring fingers. They may be removed for replacement of lamps by pulling away from the dial from behind.

DECLINATION AXLE

The declination axle is mounted at the upper end of the polar axle housing in two precision ball bearings, one at each end. It is a fabricated steel weldment which further insures rigidity of the telescope. As with the polar axle, its hollow center is used for passage of electrical power leads.

Within the housing for the declination drive mechanism is a slip ring assembly, the internal rotor of which is mounted on the end of the declination axle. The stator is stationary with the housing. Through this slip ring passes power for the 115 volt AC convenience outlets on the tube of the telescope and the secondary mirror focusing drive.

On the opposite end of the declination axle is a flange to which the tube center section is mounted. This connection is made to allow for linear adjustment of the tube position to accommodate balancing about the declination axis.

DECLINATION DRIVE

The declination drive is contained in the housing opposite the telescope tube at the upper end of the polar axle housing. Its location not only serves to minimize driving linkages, but makes use of its mass as a partial counterweight for the tube.

The drive mechanism incorporates a servo driven worm similar to the right ascension drive, except that no tracking motor, and hence no differential gear train, is necessary. The large worm gear in this case is attached to the declination axle which rotates, and the mechanism remains stationary with respect to it. The worm drive mechanism can be pivoted slightly to accommodate balance adjustment. A guide-set motor with a tachometer-generator is used for control purposes which drives the worm through a magnetic clutch. The clutch becomes disengaged when a "slew" command is given. At this time, a slew motor is energized which moves the telescope at a faster rate. Upon cessation of the "slew" command, power to the slew motor is cut off and the clutches are re-engaged and acts initially as a brake. The servo amplifier for the guide-set motor is located inside the flange of the polar axle housing.

Four captive screws, one near each corner of the outer surface, hold the cover to the base of this assembly. Two dowell pins, one at each end, hold the cover in place after the screws have been loosened. The cover should be carefully lifted away from the base since it weights approximately 25 pounds.

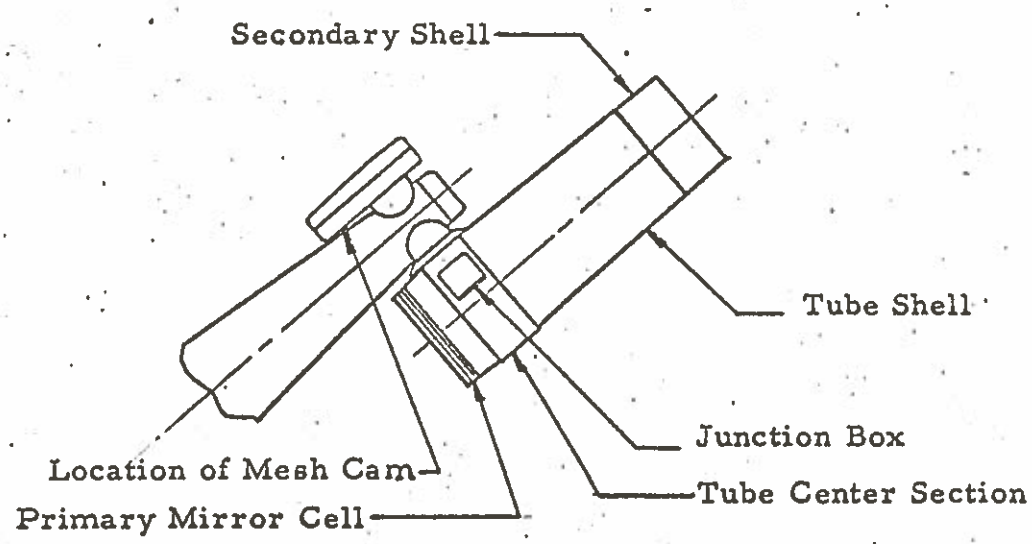
A separate 90V DC torque motor drives against a spur gear located behind the worm gear as in the right ascension drive to put a constant preload torque on the gear mesh. This insures that backlash will be minimized when the telescope is being guided at the slow guide rates.

TUBE CENTER SECTION

Developed from a double-walled, ring-like aluminum weldment the tube center section mounts solidly to the flange provided on the end of the declination axle. It is fastened in such a way that by loosening four screws it may be moved up or down, providing a means of accurately balancing the telescope tube assembly around the declination axis. A lead screw is provided for ease of making this adjustment, and is conveniently accessible at the lower end of the telescope tube assembly.

The tube center section has a 3/8-inch-thick outside wall suitable for mounting finding telescopes and guide telescopes. An electrical box mounted on the side of the tube center section houses a termination point for the wiring from the slip ring assembly and junction for the secondary mirror focusing drive. It also provides 115 volt AC outlets for accessories and 6 volt AC outlets for reticle lights through dimmer controls. Hanging from the junction box is the focus switch for the secondary mirror drive.

The primary mirror cell attaches to the lower side of the tube center section and the tube shell to the upper side.

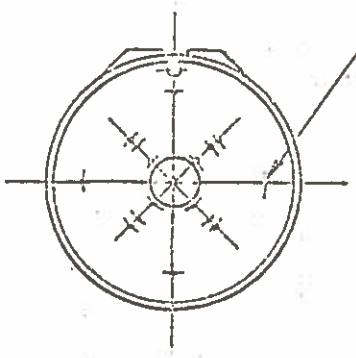


PRIMARY MIRROR CELL

The primary mirror cell is a double-wall aluminum weldment mounted to the lower face of the tube center section. The rear surface of the cell assembly is machined and provided with a 4-inch-diameter locating hole for precision alignment of instruments. This surface is also provided with tapped holes for ease of instrument attachment.

Several rings of removable counterweights are supplied which may be secured at the periphery of the lower surface of the primary mirror cell. Each ring consists of six equal segments of cadmium plated steel. Each segment may be attached to any other segment enabling the tube to be properly balanced when off-axis instruments are mounted.

The primary mirror is supported within the cell on a collimating tubular post which extends through the center hole in the mirror. It is held fast by means of pressure pads on the sides of the post for radial support and at either end of the post for axial support. The primary mirror may be centered in the cell by means of adjusting screws in the rear surface of the collimating post. It may be tilted by means of push-pull screws located on the rear surface of the cell. A sky shield, consisting of a thin-wall blackened aluminum tube, is fastened to the forward pressure pad to prevent skylight from entering the field of view at the Cassegrain focus.



TUBE SHELL

Bolted to the upper face of the tube center section is the tube shell which is a slightly tapered aluminum cylinder. It contains heavy gauge, internal mounting rings at either end and is of welded construction.

Internally, along one side, a coiled wire is secured similar to a long helical tension spring. This device is a wire cage which conveniently provides a passage for the electrical power leads to the secondary mirror drive.

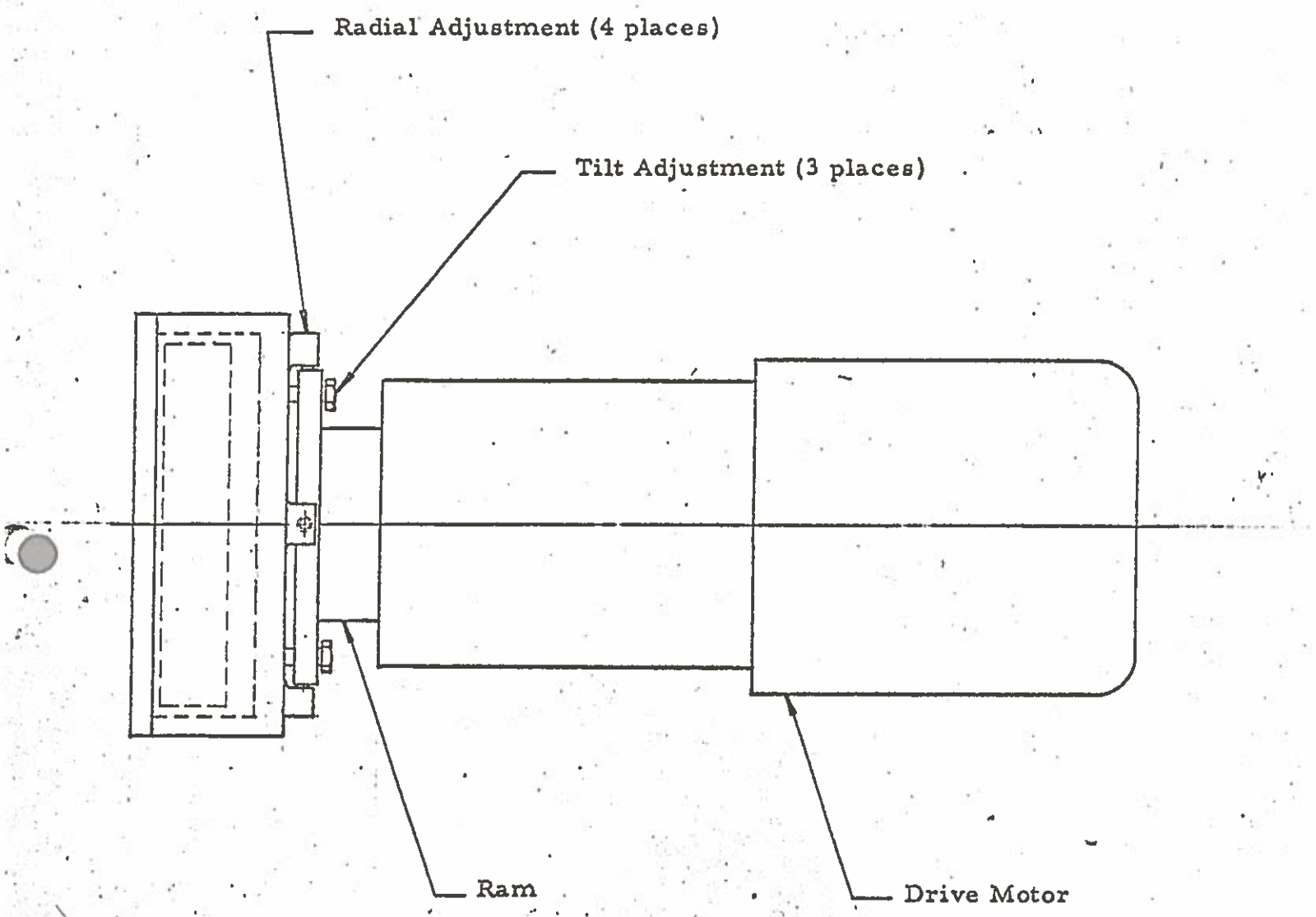
SECONDARY SHELL

The final component which makes up the telescope tube is the secondary shell. It mounts to the upper surface of the tube shell and is also constructed of aluminum. An aluminum tube cover fits into the upper end to protect the inside of the tube and reflecting surfaces from dust when the telescope is not in use.

Within the secondary shell the secondary mirror drive is supported by means of four tensioned, aluminum struts. The drive motor is mounted to the upper end of this mechanism, and a focusing ram protrudes from the lower end to which the secondary mirror cell is attached. The ram is supported radially by two sets of ball bearings, four bearings in each set. The bearings are relatively small in diameter, and are mounted perpendicular to the longitudinal axis of the ram so that it may roll against the outer races. Two bearings in each set are adjustable so that an equal preload may be established in all bearings to insure rigidity. Total longitudinal travel of the ram for focusing purposes is ± 1/2-inch from its nominal position.

The secondary mirror cell is mounted on the lower end of the ram and may be adjusted radially by means of four set screws located at the periphery of its base. The mirror is held within the cell by a removable ring next to the reflecting surface, and an adjustable ring behind, which also serves as a stiff spring. Tilt alignment of the secondary mirror cell with respect to the ram is accommodated by means of three push-pull screws on the flanged end, or plate, on the end of the ram.

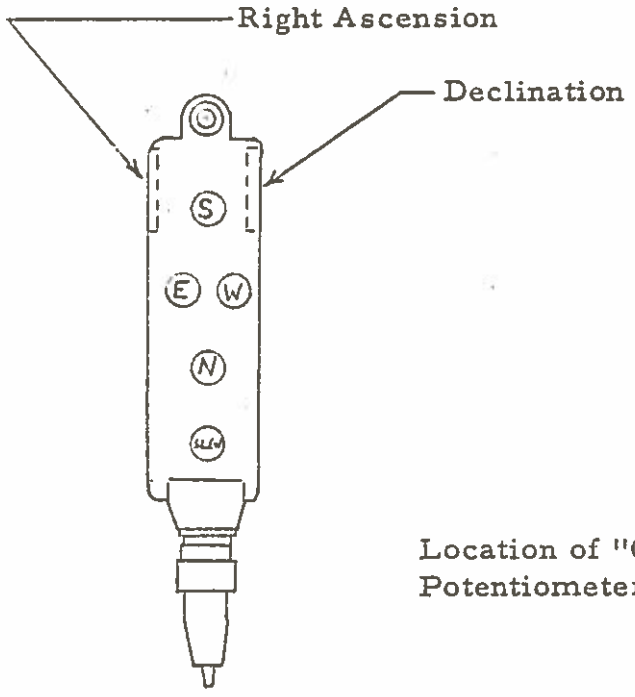
SECONDARY MIRROR AND DRIVE



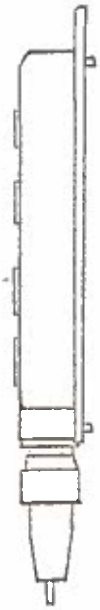
PUSHBUTTON CONTROL PADDLE

For convenient control of the telescope position, a portable pushbutton control paddle is provided at the end of a Neoprene-covered cable. The cable is connected to the telescope at the skirt on the flange of the polar axle housing, and a hanger is provided for the paddle on the base.

Five pushbuttons are located on the upper side of the paddle, four of which are for directional designation, and the fifth for fast, or "slew" speed. Each of the four directional buttons has two positions. When a button is depressed lightly the telescope will run at minimum, or "guide" speed. By pushing all the way down, the telescope will run at intermediate, or "set" speed. When any of the directional buttons is held all the way down and the separate slew button is also pressed, the telescope will run at fast, or "slew" speed. Adjustment potentiometers for setting the "guide" speed are contained within the paddle assembly, and their adjustment is described in the Electrical System section of this manual.



Location of "Guide" Speed Potentiometer Adjustments



ELECTRICAL SYSTEM

The telescope is designed to operate on 115-volt AC single phase, 60 cps power. In the event available power is at some other level, a transformer should be employed to assure that proper voltage is applied to the terminal strip in the base. A separate circuit is provided for the right ascension tracking motor, should power of controlled frequency be available. Otherwise, the tracking motor may be driven by direct line power.

All power in the telescope, with the exception of that to the right ascension dial motor, is turned on and off with the lockswitch located on the flange of the polar axle housing. All power conversion for the various drive motors, the 6.3-volt outlets in the junction box, and the position dial lamps takes place inside the flange of the polar axle housing. Within the flange are two servo control amplifiers (one for the right ascension servo motor and one for the declination servo motor) and a DC power supply chassis which contains step-down transformers for the low volt requirements, solid state switching relays for the slew circuits, fuses, and adjustments for torque motor and clutch voltages.

The location of these electronic components in the flange of the polar axle housing not only provides convenience, but minimizes the lengths of wires. The electrical schematic and electrical diagrams furnished provide further detail on the parts used and their locations.

There are three sets of adjustments located on the triangular-shaped chassis of the power supply (see sketch at the end of this section). The first two adjustment rheostats, marked "RA" and "Declination Clutch", are used to control the braking deceleration rate of the clutches while the telescope is slowing down from slew speed. Turning these clockwise

increases the voltage on the respective clutches and decreases the deceleration time. These should be set so that the clutches, when acting as brakes during the deceleration phase of slewing, apply sufficient torque to stop the telescope within a time of three to five seconds. Faster braking may put unduly high stresses on the telescope gearing. A second set of adjustments, consisting of two trim pots on the second circuit board of the power supply, control a time delay after which full voltage is applied to the clutches to give maximum torque for tracking, guiding, and setting. This time delay of approximately five seconds is set at the factory and should not require further adjustment. Maximum rated voltage for the clutches is 90-volts DC and higher voltages will not increase the clutch torque.

Another set of two rheostat adjustments, located approximately in the center of the power supply package, are for setting the individual voltages to the right ascension and declination axle preload torque motors. These increase the torque on the respective axles with clockwise rotation. Maximum voltage to the torque motors must be limited to 100-volts DC to protect the motors from burnout.

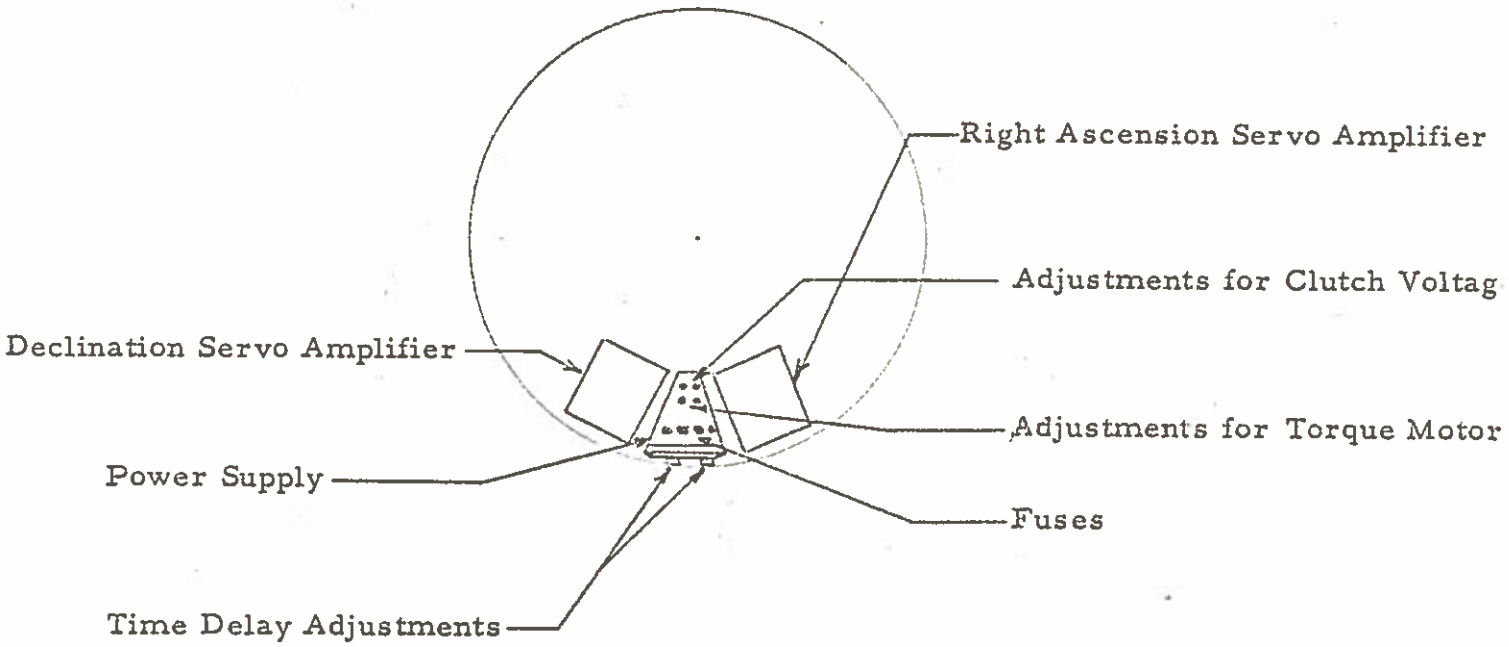
The two servo amplifiers are mounted on either side of the power supply chassis inside the flange of the polar axle housing. As viewed from the rear, the one on the right nearest the drive mechanism drives the right ascension guide-set motor, and the one on the left drives the declination guide-set motor. Their design and functional operation are identical. The difference in voltage between the command signal from the pushbutton control paddle and the output of a tachometer-generator is fed to the amplifier whose output drives the corresponding guide-set motor. The phase of the command signal determines direction of the servo motor. The command voltage transformer has a center tapped secondary winding with eight volts available on either side. The center tap is grounded through a trim pot adjustment which permits balancing the two sides of the winding

for symmetrical voltage control. A 100 ohm trim pot, known as the balance adjustment, is located on the amplifier circuit board and is the outermost of the two adjacent trim pots. The innermost trim pot adjusts amplifier gain, and for this application has little function. The maximum speed of the servo motors, corresponding to the fully depressed position of any of the paddle pushbuttons, can be monitored with an AC voltmeter across the output of the tachometer generator. This should range from 15 to 25 volts AC, depending on the impedance of the voltmeter and the actual motor speed.

The low speed, or "Guide" command is adjustable through two trim pot controls located in the pushbutton control paddle. The location of these is noted in the control paddle sketch in a preceding section of this manual. Turning the screw of either trim pot clockwise increases the guide speed for that axis, and counter-clockwise decreases it. If the speed in opposite directions is not the same, adjustment of the balance trim pot located in the servo amplifier, as described above, must also be made. Minimum speeds of one revolution per second of the servo motor shaft are easily attainable. (Note that the visible output shaft of the declination servo motor is not the motor shaft, but the shaft of a speed reducer, and this has a rate about 1/35 of that of the motor). If either of the trim adjustments in the paddle are turned too far counter-clockwise, the corresponding motor will cease to run.

The 16-inch telescope has only two sets of motor limiting interlock switches. There are no restrictions to rotational motion because of the slip rings used on each axle. There are microswitch interlocks located in each drive which disable all drive motors whenever either drive is in the "out of mesh" position for balancing the telescope. The second interlocks are limit switches on the secondary mirror drive. Whenever the mirror is driven to its limit in one direction, the motor will stop, but may be directly driven in the opposite direction merely by pressing the corresponding control button.

The fuses provided are located in the servo amplifiers, on the top of the DC power supply chassis, and in the junction box on the telescope tube. Fuse values are as indicated on the wiring drawings and individually control circuits for the focus motor, all DC power, the slew control circuits, the guide-set motor circuits and the 115-volt instrument power outlets. The main power circuit breaker on the base of the telescope controls all incoming power except as noted at the beginning of this section and is of the resettable type.



FOUR-INCH F/9 FINDER TELESCOPE

The basic finder telescope consists of four separate sub-assemblies. These are the objective lens assembly, the tube, the eyepiece assembly, and the mounting rings.

The objective lens is a cemented doublet mounted in an aluminum cell. The cell and lens together may be removed from the rest of the finder telescope for cleaning by unscrewing at the joint located approximately 2-inches below the top of the finder telescope. The four radial screws located below this joint should not be removed, as these are locked with nuts on the inside which cannot be reached unless the upper cell is first removed. The lens and cell assembly will normally not need removing for cleaning, as only the upper surface should accumulate dirt. Cleaning should be carried out carefully, using the normal precautions required for cleaning any precision coated lens.

The finder telescope tube is a solid aluminum tube with two internal glare stops. At the lower end is located a small rheostat used for dimming the reticle illumination lamp. A power cord for the lamp which emerges from the side of the finder tube is designed to plug into the saddle junction box of the 16-inch telescope. Note that in most cases there is a separate rheostat for each outlet on the junction box and that the two rheostats will be interacting. For normal use, the one on the junction box should be turned all the way clockwise, and the one at the finder telescope used for controlling lamp intensity.

The eyepiece assembly consists of the eyepiece, the glass reticle, and the lamp assembly for illuminating the reticle. The eyepiece is mounted on a coarse thread and should be rotated for focus adjustment. Focus is correct when both the reticle and a star are in sharp focus

and there is no apparent parallax between the star and the reticle line. The reticle lamp may be removed for replacement by unscrewing the knurled fitting adjacent to the eyepiece. The lamp normally used is a #328L 6.3-volt lamp. Similar 12 and 24-volt lamps are available for special applications.

The location of the focal plane of the reticle has been set at manufacture to be precisely at the focal plane of the objective lens. If for any reason parallax is noted between a star and the reticle or the two cannot be gotten into sharp focus at the same time, it may be necessary to adjust either the reticle position or the objective lens position. The eyepiece assembly can be removed from the finder telescope by unscrewing the four socket-head cap screws located around the eyepiece. Care should be taken in removing this, as there are interconnecting wires in the lamp assembly to the tube.

The mounting ring assemblies each have three radial adjusting screws operating through a Teflon support ring which grips the tube of the finder telescope. To adjust the whole finder telescope position with respect to the Cassegrain telescope tube, one screw on each ring may be loosened and the entire finder tube moved up or down to the desired position. Note that the finder must be supported while this is being done. To align the reticle of the finder telescope with the right ascension and declination motions of the telescope, the same procedure can be followed, except that the finder telescope is then rotated to the desired position. Finally, to align the axis of the finder telescope with the axis of the Cassegrain telescope, adjustments can be made at just the lower mounting ring. With a star located at the center of the field of the Cassegrain telescope, the axis of the finder can be adjusted by loosening one screw in the lower mounting ring and tightening either of the others, repeating this procedure with different screws until the same star is accurately centered on the reticle. At this point, all three screws should be snugly tightened.

The standard eyepiece furnished with the finder has a 28 mm. focal length, plus giving a full field of approximately 1-1/2-degrees.

A metal dust cap is provided for protecting the objective lens when the telescope is not in use.

RIGHT ASCENSION FREQUENCY CHANGER AND AMPLIFIER

The frequency changer and power amplifier system provides for selection of any right ascension tracking speed for the telescope, which is within two ranges - either ± 1% or ± 4% of sidereal speed. The system as supplied operates on 60 cycle per second powerline frequency, although a stabilized frequency source may be used instead for the input. The frequency changer uses an accurate variable speed and offset resolver arrangement with an output frequency which can be varied from the 60 cps input by turning the control dial. The output frequency is fed, in turn, through a power amplifier and into the right ascension tracking speed drive motor when speeds other than sidereal tracking speed are required. Controls for the frequency changer are located on the telescope base pedestal. One toggle switch, labeled "Line Variable" is used to turn on the frequency changer and amplifier. In the line position, the telescope tracking motor is connected directly to the powerline frequency and drives the telescope at sidereal rate directly. In the variable position, the frequency changer is turned on and the tracking motor is supplied with whatever rate has been selected.

The frequency changer has two scale ranges, ± 1% and ± 4%. A second toggle switch selects either of these ranges. The dial is calibrated with two scales starting from zero at the top. The indicated rate is expressed as a percent of sidereal rate and is faster or slower, depending on which side of zero the dial is positioned.

The power amplifier for the frequency changer is a commercial hi-fi type of amplifier, and a wiring schematic and instructions supplied by the manufacturer are appended to this manual. The amplifier is mounted in a steel electrical junction box located outside of the telescope on the side of the telescope pier. Electrical adjustments of the amplifier are

shown and explained on the electrical schematic for the frequency changer (Drawing D-25993). An impedance matching circuit at the input of the amplifier consists of a capacitor and potentiometer. The capacitor value, nominally 2 mfd., has been set at the factory to give the best wave form with the particular resolver used in the frequency changer. The potentiometer adjustment is then made to minimize voltage fluctuations produced by rotation of the resolver. Adjustment of this potentiometer is made by observing the fluctuations in the output voltmeter located on the front door of the frequency changer amplifier cabinet and adjusting the potentiometer until the fluctuation amplitude is minimized. Note that the frequency changer must be running and that the dial must be set at some value other than zero when this adjustment is made.

The amplifier input gain is set close to maximum, and the output which goes through a variable transformer is then adjusted to give a nominal 115-volt output, as read on the voltmeter located on the amplifier housing door. This voltage should be monitored periodically and adjustments made if required, to compensate for aging of the amplifier components. Note that there is a lock-nut on the shaft of the variable transformer which must be loosened before the transformer shaft can be turned.

CAMERA

The camera, Boller & Chivens 3-1/4 x 4-1/4 Rotary Shutter Telescope Camera, mounts on the lower end of the telescope in line with the optical axis. It consists of the following components:

1. Adapter Tube
2. Motor-driven Shutter Assembly
3. Plateholder Adapter
4. Filter Holder
5. 3-1/4 x 4-1/4 Plate Holder (3 supplied)
6. Knife-edge Assembly
7. Viewing Eyepiece

The adapter tube serves to securely mount the camera on the telescope, in addition to accurately placing the film plate-holder at the nominal Cassegrain focus. The adapter tube bolts to the machined lower surface of the primary mirror cell exactly over the 4-inch locating hole. At the lower end of the adapter tube the shutter assembly is attached, immediately beneath which is the module holder.

Two slots are provided in the module holder for insertion of various devices. The first slot nearest the shutter assembly accommodates a filter holder. The second, or larger, slot may be used to insert a plate holder, the knife-edge assembly, or the viewing eyepiece. The latter three pieces are locked in place with a knurled thumb screw, but the filter holder requires no lock. The filter holder should be in place whether or not a filter is used, in order to prevent light leakage into the camera.

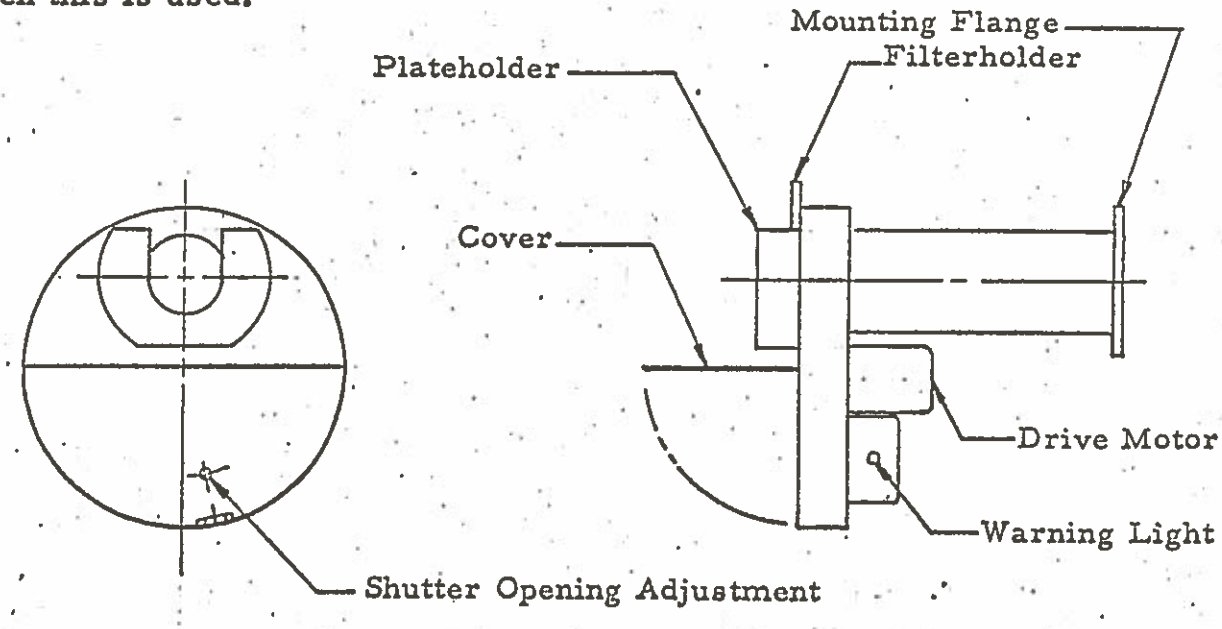
The shutter assembly contains a rotary focal plane shutter with an adjustable slot opening. Access to this adjustment is gained by loosening a knurled nut which clamps a hinged lid on the lower surface of the assembly. The shutter consists of two circular blade segments which are clamped together by means of another knurled nut. When this clamping nut is loosened the blades may be moved with respect to each other, and the exposure time set from the engraved numbers on the movable blade. For time exposures, the shutter must be fully open to the "T", or time, position to avoid any possible vignetting of the photographic field. The blades should always be left in a clamped-together condition, and the access lid closed when adjustments are completed.

The shutter is driven through a gear train from a 115 volt AC motor mounted on the upper surface of the shutter assembly. The shutter junction box, located beside the motor, provides a two-position toggle switch for selection of pre-set or manually timed exposures. A red light on the opposite side of the box remains on when the shutter is in the open position during manually timed exposures. Hanging from the box is a pendant push-button which operates the shutter. The button should be held down for approximately two seconds each time it is pushed in order to maintain proper shutter movement. For manually timed exposures, the button is pushed once to open and a second time to close the shutter. Automatic exposures may be set in increments from 1/60 to one second. Since the shutter drive motor is a synchronous AC type, designed for operation at 60 cycles, a different frequency will correspondingly affect shutter speed.

The knife-edge assembly is used for focusing the telescope to the focal plane of the plate holder. To focus by this method, the knife-edge should first be moved as far off-center as possible (away from the optical axis) by turning the knurled thumb screw adjustment provided

on the lower surface. Next, the telescope should be aligned so as to place the star under observation just on the knife-edge, but with no dimming, as seen with the eye about one inch behind the knife-edge. A hand held eyepiece may be helpful in locating a star image with respect to the knife-edge. Cut-off will start to occur as the star is "moved" into the knife-edge either by moving the telescope, or by moving the knife-edge itself with the adjustment provided. Should cut-off start on the opposite side of the star from the knife-edge, the knife-edge is in front of the focal point and the secondary mirror should be moved upward. If cut-off starts on the same side, the knife-edge is behind the focal point and the secondary should be moved downward. Optimum focus is obtained when movement of the knife-edge causes the complete star image to dim uniformly. This point can be determined through trial and error with small movements of the secondary mirror.

The viewing eyepiece is interchangeable with the plate holder and the knife-edge assembly in the slot provided in the module holder. It consists of a one-inch nominal focal length Erfle-type eyepiece which permits viewing the central field which is to be photographed. The eyepiece may be focused directly, avoiding the need for re-focusing the telescope when this is used.



CASSEGRAIN EYEPIECES

An eyepiece holder is provided with the telescope for use at the Cassegrain focus. With this are a series of four different focal length eyepieces with parfocalized adaptors so that these may be used interchangeably with little or no refocusing of the telescope. Each adaptor is to be kept with its eyepiece, and the eyepieces interchanged by unthreading one adaptor and threading in the new eyepiece with its adaptor. The thread provided is long enough to provide some direct focusing adjustment, although a more convenient adjustment is to move the Cassegrain secondary mirror of the telescope.

Each of the eyepieces can also be used in the eyepiece adaptor plate of the 3-1/4 by 4-1/4-inch camera. In addition, a 32mm Erfle type eyepiece has been provided which can also be used interchangeably with the camera or the eyepiece adaptor.

ASSEMBLY INSTRUCTIONS

For shipment, the Boller & Chivens 16-inch telescope is broken down into several major sections as follows:

1. Sole plate (usually shipped in advance of the telescope).
2. Base
3. Polar axle assembly including the polar axle, polar axle housing, the drives, and the tube center section.
4. Primary mirror cell with mirror installed.
5. Upper tube section, including tube shell and secondary shell with mirror installed.
6. Finder telescope, pushbutton control paddle, and small parts.
7. Eyepiece holder and eyepieces.
8. 3-1/4 x 4-1/4 camera with plate holders.
9. Extra counterweights.
10. Steel cable sling for hoisting polar axle assembly.

Tools Required for Assembling Telescope

A. 1. Complete set of hex allen wrenches 3/32" through 1/2"

2. 12" crescent wrench
3. 8" crescent wrench
4. Various sizes of screw drivers

5. 3/8" drive ratchet wrench with a 3" or 6" long extension shaft

6. 7/16" hex socket to fit 3/8" drive ratchet wrench

7. 1/2" box-end wrench

8. Small 3/8" end wrench (thin pattern). This wrench used for adjusting the secondary mirror tilting screws.

9. 1/4 drive socket set

10. Set of three tee-handled hex allen wrenches (furnished by Boller & Chivens with telescope).

B. Assembly Instructions

1. On each sole plate stud install one 1-inch nut, followed by one set of spherical washers.

2. Remove the two round side covers on the base. Lift base onto sole plate, and secure it with a second set of spherical washers and nuts on each stud.

3. Lift polar axle assembly with slings.

4. Hoist assembly onto base, being careful not to damage the wire stored in the end of the polar axle, and that the projection on the polar axle hub fits into the machined hole in the base as it is lowered into position.

5. Rotate the polar axle by means of the right ascension slew motor flywheel inside the skirt until bolt holes align with tapped holes in the base.

6. Secure polar axle assembly to base with eight 5/8-18 machine bolts.

7. Remove slings and eyebolts and install special screw plugs in eyebolt holes.

8. Remove declination drive cover by loosening the four captive screws which hold it to the drive case. Carefully lift the cover off of the dowel pins at each end, since it weighs approximately 25 pounds.

9. Rotate declination slew motor flywheel until the axis of the tube center section is in a vertical position. This can be determined by watching the declination dial until it indicates the local latitude angle.

10. Install tube trim weight. Bolts come through the outside wall of the tube center section from the inside.

11. Unpack the upper tube section and disconnect the secondary shell assembly from the tube shell.

12. Install tube shell by bolting it securely on the tube center section. As this section is placed on the tube center section, the focusing motor wires for the secondary mirror must be brought up through the inside of the tube. Align the sections such that the holes in the flanges for the wires coincide with each other. A spring-like cover for these wires hooks onto the small tube protruding from the lower internal ring of the tube shell and the other end hooks onto a small post at the top end of the tube shell. This spring serves as a wire way for the secondary focusing motor wires.

13. Remove the four screws holding the cover on the secondary mirror focus motor drive.

14. Remove three small screws holding the wire cover attached to one of the finished struts.

15. Install secondary shell onto tube shell. Route the focusing wire through the flange as it is attached.

16. Route the focusing motor wires across the secondary mirror support strut, and re-install the wire cover on the strut.

17. Attach the wires to the terminal strip near the focusing motor. The wire colors should match the corresponding motor wire colors that are attached at the terminal strip.

18. Re-install the motor cover

19. Unpack the primary mirror cell

20. Attach sky shield to the center collimating post.

21. Attach mirror cell to bottom of tube center section, guiding the cell over the balance adjusting screw. Securely bolt the cell to tube center section. Use the largest of the special tee-handled hex wrenches supplied with the telescope for reaching these screws.

22. Install the counterweights to the lower surface of the mirror cell. Note that some of the counterweight segments have a large hole in the center, and should be positioned so as to provide access to the declination balancing screw. The remainder of the weights should stack to make equal rings on the rear of the cell.

23. Attach the guide telescope to the side of the tube center section.

24. Attach the camera to the rear of the mirror cell. The telescope was left in balance when it was shipped and should nearly be so now.

25. Connect the wires from the lower end of the polar axle assembly to the terminals in the base. Install jumper connections to tracking motor leads at this point unless a separate tracking oscillator is to be used.

26. Connect 115-volt wires to appropriate terminals in the telescope base. Be sure to provide a suitable ground connection and also be especially careful to insure that the grounded side of the line is connected to the proper terminal.

27. Plug the pushbutton paddle into the receptacle on the polar axle skirt.

28. Install the polar axle housing cover, and the base side covers.

29. The telescope is now ready to operate. Slew the telescope carefully and follow the balancing procedure in this manual to insure that the telescope is in complete balance. See other sections of this manual for dial setting instructions and polar axle and optics alignment adjustments.

BALANCING PROCEDURE

The balance around the declination axis must always be checked first, followed by final balancing around the right ascension axis.

1. With the declination axle exactly horizontal east and west and the tube vertical, move the declination worm out of mesh. This is accomplished by turning the designated cam on the back of the declination transmission case 180°. As instrumentation is added to the back of the cell, equivalent amounts of counterweight segments should be removed. If the instrumentation is off axis, the counterweight segments may be built up unevenly on the opposite side to bring the tube into balance in this vertical position. Balanced condition is best observed by watching the declination indicating dial as the tube is rocked by hand within the limits of the lash of the declination transmission in its "unmeshed" state.

2. After arriving at the best balanced condition with the tube vertical, remesh the declination worm gear and slew the tube down into a horizontal position. Unmesh the declination worm gear and again determine the out of balance. This time correct the out of balance by unclamping the declination axle at the tube center section. Loosen the 4 clamp screws 1/2 turn only. Rotate the lead screw located at the rear of the mirror cell, jacking the tube perpendicular to the declination axis to a balanced condition. Tighten the 4 clamps. Remesh the declination worm into the worm gear before trying to operate. Balancing in these two positions should bring the telescope tube into complete balance around the declination axis.

3. With the declination axle in its horizontal east-west position, unmesh the right ascension worm gear. The meshing cam for the right ascension drive is located on the front face of the polar axle housing. Turning it 180° slightly unmeshes the gear. The large right ascension counterweight can be moved radially out or in by means of a screw located in the skirt of the polar axle housing. Turning the counterweight adjusting screw clockwise will increase the counterweight movement about the polar axis. Again, watching the hour angle dial and rocking the telescope by hand within the limits of the lash of the right ascension transmission in its "unmeshed" state, the complete telescope can be brought to a balanced condition. If more or less counterweight is desired and cannot be reached by this adjustment, the rear cover may be removed and larger increments of weight may be added or removed.

Remesh the right ascension worm gear before operating the telescope. Electrical interlocks are provided so the telescope cannot be operated when either drive is out of mesh. If the telescope fails to operate, a check should be made that both worm gears are in complete mesh.

MAINTENANCE

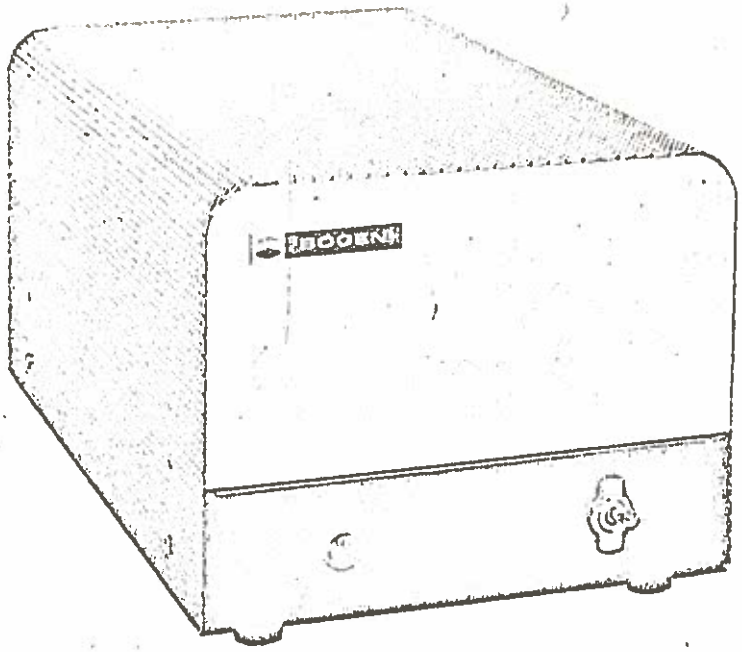
The telescope was manufactured by experienced craftsmen and lubricated during assembly for long-term service. Under normal operating conditions, it will require little or no maintenance. The right ascension tracking motor and the secondary mirror focus motor can be oiled lightly at one-year intervals. Oil holes are marked with yellow or red paint, and no more than three or four drops of light viscosity machine oil should be added at one time.

The right ascension and declination primary worm gears should be greased at approximate six-month intervals. The recommended lubricant is Anderol No. L-757 grease, with powdered Molybdenum Disulphide added at the rate of two teaspoons per pint of grease. The Anderol L-757 has a better temperature coefficient than petroleum grease and will have a very long life.

Open spur gears in the right ascension and declination drives should also be lubricated at six-month intervals, using Anderol No. L-757 grease without the added Molybdenum Disulphide. Ball bearings are generally sealed or permanently lubricated and need no further attention. However, should bearings be removed or exposed during maintenance work, they can be repacked, again with Anderol No. L-757 grease without Molybdenum Disulphide.

APPENDIX 1

BOGEN



MODEL MO30A

30 WATT BOOSTER AMPLIFIER

LEAR SIEGLER, INC. / ISi
BOGEN COMMUNICATIONS DIVISION
P.O. BOX 500
PARAMUS, N.J. 07652

INSTALLATION AND OPERATING MANUAL

READ THOROUGHLY BEFORE OPERATING EQUIPMENT

IMPORTANT: BEFORE INSTALLATION READ CAREFULLY CAUTION NOTES ON PAGE 8

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DESCRIPTION

The Bogen MO30A is a booster amplifier capable of delivering 30 watts of audio power. It is ideal for installation with sound systems in industrial plants, stadiums, theaters and auditoriums. This high quality amplifier has exceptional power handling ability over the entire range of audio frequencies.

The MO30A has provisions for high and low impedance inputs. Balanced outputs are provided for 4, 8 and 16 ohm speaker impedances and for operation with 25 volt and 70 volt line speaker systems. This eliminates difficulties encountered in speaker matching when unequal amounts of power are required for different speakers of a distribution system. Sockets are provided on the chassis for power to an external preamplifier.

Two or more MO30A booster amplifiers may be connected in parallel for installations requiring more than 30 watts of power. This is made possible by interconnecting the C.P. (Cathode Paralleling) jacks of the unit and paralleling the inputs and outputs of the units. The C.P. connections tie the feedback components of the amplifier together, thereby balancing their characteristics.

TECHNICAL SPECIFICATIONS

POWER OUTPUT: 30 watts

HARMONIC DISTORTION: Less than 2% at 30 watts output.

FREQUENCY RESPONSE: ±1 db, 4 to 70,000 cps.

POWER RESPONSE: 30 watts at less than 5% distortion, ±1 db from 25 to 50,000 cps.

DUTY CYCLE: Continuous.

HUM: -75 db.

DAMPING FACTOR: 5 to 1

REGULATION: 2 db or better.

SENSITIVITY:

High impedance input: better than 2 volts;
Low impedance (using TL600 transformer): better than 0.5 volt.

INPUTS:

High impedance: 0.5 megohms;
Low impedance: 500/600 (balanced) using TL600 transformer;
Bridging: 10,000 ohms using TL10K transformer.

OUTPUTS: 4, 8 and 16 ohms balanced, 25 volt balanced 20.8 ohms, 70 volt balanced 163 ohms.

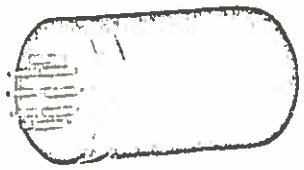
POWER REQUIREMENTS: 110 watts at 1 amp for 117 volt, 50/60 cycle operation.

TUBES AND RECTIFIERS: One 7247, two 7868, three silicon rectifiers.

DIMENSIONS: 8" wide, 13" deep, 6¼" high.

WEIGHT: 16 lbs.

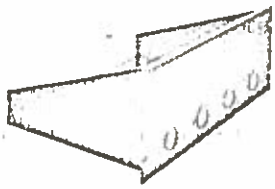
ACCESSORIES



LINE MATCHING TRANSFORMERS — Models TL600 and TL10K constitute plug-in type line input transformers.

The TL600 is intended to operate with a 500/600 ohm line carrying wide range program material.

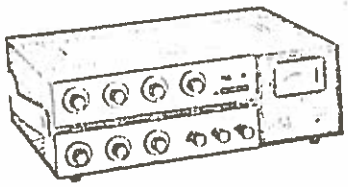
The TL10K is designed to bridge across 500/600 ohm lines carrying wide range program material. As many as twenty may be used across a line without the total load impedance falling below the nominal line impedance.



MODEL RPK-18 RACK PANEL MOUNTING KIT — The model RPK-18 Rack Panel Mounting Kit is available to mount the amplifier in any standard 19" rack panel. Two MO30A amplifiers will fit on one RPK-18. Panel includes all necessary cutouts.

Finish is grey metalustre and size is 19" w x 7" h x 13" d.

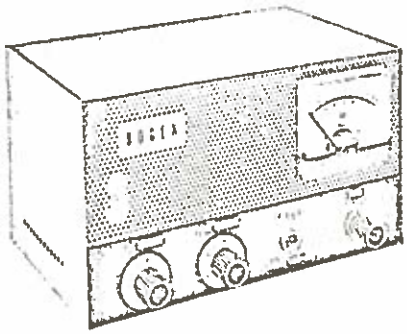
BOGEN PREAMPLIFIERS
DESIGNED FOR USE WITH M30A



MODEL MXM-A...7-INPUT MIXER PREAMPLIFIER- higher gain – outstanding sensitivity – excellent signal to noise ratio – broadcast quality – high output at extremely low distortion. The MXM-A is self-powered, accommodates 5 high or low impedance microphones, or 4 microphones and a magnetic phonograph or tape deck. Two auxiliary inputs are connected to a fader type control. Each channel is regulated by a separate gain control and a master gain control is also provided. A bridging input accepts signals from a remote preamplifier or zero level line. Features: individual speech filters for each channel; calibrated low frequency filter; output level meter; variable level markers which permit instant resetting of controls to previously determined levels. May be remotely controlled or have remote precedence. Up to 3 units may be paralleled to accommodate up to 21 inputs.

SPECIFICATIONS

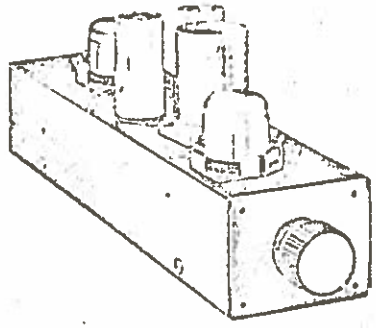
Power Output: 20 V into high-imp. load at 1%; 4 V into 600 ohms at 1%; (from bridging output, 0.1 V into 1 Meg.) Frequency Response: 18–38,000 cps ± 1 db. Output Impedance: high-imp. (less than 3,000 ohms); 500/600 ohms with TL600 (broadcast quality) plug-in transformers. Input Sensitivity: high-imp., 2 MV; low impedance, 0.1 MV.; Mag.; 1 MV.; bridging, 0.5 V; Aux., 0.1 V. Hum (below rated output): Microphone 60 db. Tone Control Action: treble: (10 kc) + 12 db to –12 db; bass: (50 cps) +14 db to –8 db. Tubes: 4-12AX7A, 1-7247, 1-12AU7A, plus 3 silicon rectifiers. Power Consumption: 25 watts, 117 VAC; 50/60 cps. Overall Dimensions: 16½" W, 12" D, 4¼" H, Shipping Weight: 20 lbs.



MODEL RP-2 . . . 2-INPUT MIXER-PREAMPLIFIER – Designed for use at remote pickup points. Contains separate input channels for one microphone and one phonograph. Separate volume controls for each channel permit mixing of inputs. The output is designed to feed either a booster amplifier or a low impedance line separately or simultaneously. A bass cut-off switch provides speech clarity. Enclosure with VU meter (as illustrated) is available.

SPECIFICATIONS

power consumption: 20 watts, 117 volts ac, 60 cycles. gain: microphone: 76 db, phono: 35 db, sensitivity: microphone: 3.5 mv., phono: 0.4 v. bass cut: 20 db. output impedance: high impedance: cathode follower driven; minimum recommended lead resistance – 10,000 ohms. Low impedance: 600 ohms (50 and 200 ohms). input impedance: high impedance: ½ megohm, convertible to low impedance by use of plug-in transformers for 50, 150-250 or 6pp ohms. pilot light: #47. tubes: total 4—2-6SF5, 1-6J5, 1-6X5GT. dimensions: 11" w. x 5¼" h. x 7⅜" d. (excluding knobs). With cage, height is 6½". weight: 7lbs. CAGYU2 cage with meter—optional extra.



MODEL PDR MICROPHONE PREAMPLIFIER – Designed to amplify low level signals such as the output of a microphone to level suitable for driving power amplifier or feeding to transmission line. Intended for rack mounting and plugs into model CR-1 rack without use of tools. May also be mounted in conventional manner. Volume or tone may be remotely controlled using models RVX or RTX remote control units.

SPECIFICATIONS

input: high: 500,000 ohms; low: 50 ohms (T157 input transformer): 150-250 ohms (T155 input transformer); 500 ohms (T156 input transformer). output: 10,000 ohm cathode follower; 600 ohm balanced (T161 plug-in transformer). output level: 8 volts across 10,000 ohms or + 8 dbm across 600 ohms. frequency response: 20 to 20,000 cps, +0 –1.5db. gain: high impedance 75db. harmonic distortion at rated output (high impedance input and output) 0.4% @ 20,000 cps, 0.6% @ 20 cps. signal-to-noise ratio: 68db. tubes: two 12AT7. dimensions: 3" w., 4⅝" h., 12 ⅝" long. weight: 2 lbs.

INSTALLATION

UNPACKING

The unit was carefully checked before leaving the factory. Inspect shipping container and amplifier carefully for indication of improper handling in shipment. If unit has been damaged, make an immediate claim to the dealer or distributor from whom it was purchased. If unit was shipped to you, notify transportation company without delay and file a claim.

CONNECTIONS BETWEEN COMPONENTS

Use single-conductor, low capacity shielded wire for connecting preamplifier to amplifier. Keep leads under ten feet in length, unless cathode follower output is employed.

Speakers may be connected with standard flexible line cord (zip-cord) and up to 100 feet of cable may be used without appreciable loss.

Make certain that all audio cables are kept away from speaker cables, power cables, and power transformers, and that speaker cables are kept away from power cables.

POWER

Connect the line cord to a wall outlet supplying 117 volt AC, 50/60 cycle power. Power to the amplifier may be controlled by means of the Power ON-OFF switch located on the front panel, or from the preamplifier which feeds the booster.

An AC receptacle has been included on top of the amplifier chassis to supply power not exceeding 400 watts to other components in system.

The receptacle is controlled by the Power switch, and any component connected to it will be turned off by the power switch.

A 9-prong socket marked PDR ACCESSORY is available on top of the chassis to provide plate and filament voltages to a Bogen Model PDR preamplifier.

GROUNDING THE UNIT

Ground the amplifier by attaching a wire from a GND terminal on the chassis rear to a good ground such as the metal frame of the wall outlet or a water or steam pipe.

INPUT CONNECTIONS

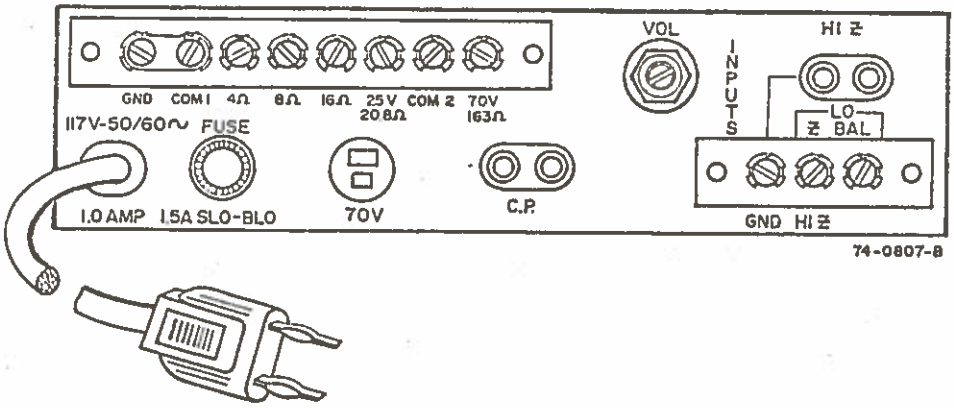


Figure 1 – MO30A Rear Panel

HIGH IMPEDANCE

Using the high impedance input, the amplifier can be driven to full output from any preamplifier capable of developing 2.0 volts across a 500,000 ohm load. Connect the output of the preamplifier to either of the input receptacles marked HI Z at the rear of the booster amplifier (see figure 1). A high impedance input may also be connected between the HI Z terminal and GND on the input terminal strip.

The high impedance input receptacles may also be used when the input signal is obtained from another power amplifier with a 70-volt output tap. Make connections to the HI Z input receptacle as shown in figure 2. The network shown in this figure is in addition to the normal load (loudspeakers, etc.) on the output of the driver amplifier.

LOW IMPEDANCE

The amplifier can be driven to full output, using the low impedance input with a TL600 input transformer, from any preamplifier capable of developing 0.5 volts across a 500/600 ohm load.

Plug the Bogen TL600 transformer into the X1 socket on top of the chassis (see figure 5). Connect the 500/600 ohm input between LO Z and GND on the input terminal strip.

The amplifier will accept a bridging input at 10,000 ohms by utilizing the Bogen TL10K accessory. The transformer is plugged into the X1 socket, and the bridging input connected to the LO Z terminals on the rear of the amplifier.

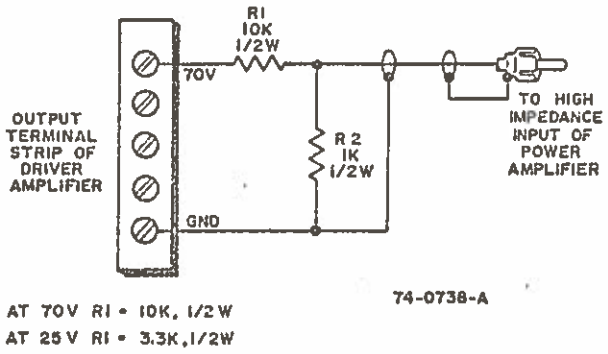


Figure 2 – Connections from Power Amplifier

OUTPUT CONNECTIONS

SPEAKERS

The MO30A amplifier may be connected to speakers rated at 4, 8 or 16 ohms or used with 25 volt or 70 volt constant voltage line systems.

For 4, 8 or 16 ohm operations, connect one lead from the speaker to the COM 1 terminal and the other to the appropriate 4, 8 or 16 ohm terminal on the rear of the amplifier chassis.

For 70 volt unbalanced operation connect leads to 70V (163 ohm) terminal and COM 2 terminal, and connect shorting wire from COM 2 terminal to GND if grounding is desired. For 70 volt balanced operation remove shorting wire between COM 2 terminal and GND and connect leads from 70V (163 ohm) to COM 2. A Jones plug # P302-CCT and class 2 wiring may be used.

For 25 volt unbalanced operation connect leads between 25V (20.8 ohm) terminal and COM 1; for balanced 25 volt operation remove shorting link between COM 1 and GND.

PARALLELING AMPLIFIERS

Two or more model MO30A amplifiers may be operated in parallel in a system which requires more than 30 watts output power. Two paralleled amplifiers will provide up to 60 watts, three amplifiers up to 90 watts.

Dual high input (HI Z) receptacles and dual cathode paralleling (C.P.) jacks are provided on the rear of the amplifier chassis to facilitate paralleling of amplifiers without wiring. When paralleling amplifiers interconnect the units as shown in figure 4. Any number of units may be paralleled to provide the desired output power. The interconnecting cable for the HI Z and C.P. receptacles should be standard audio shielded cable with phono type plugs at both ends.

NOTE: *Only transformer taps of the same output impedance should be paralleled. It must be borne in mind that paralleling outputs reduces the output impedance.*

The 70 volt outputs of two or more MO30A amplifiers may be connected in series to provide a 140 volt output voltage for two amplifiers or 210 volts for three units. To install a series hook-up, connect the 70 volt outputs of the MO30A amplifiers as shown in figure 3. The HI Z and C.P. outputs are paralleled as described above and as shown in figure 2.

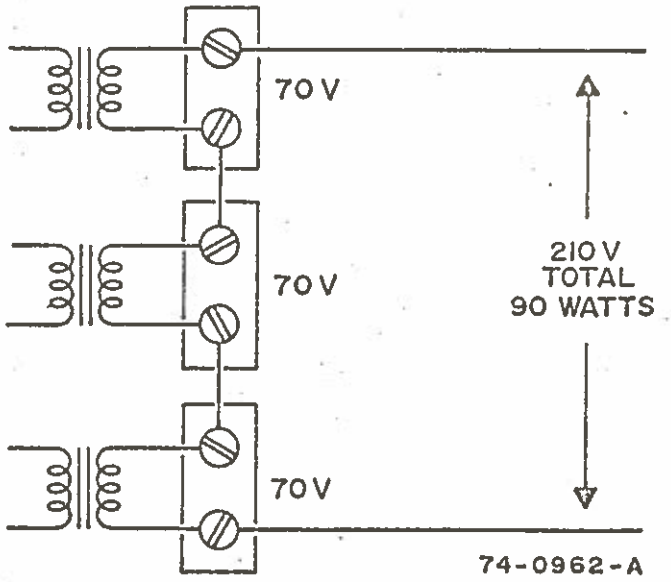


Figure 3 – Series Hookup for 70-Volt Outputs

OPERATING CONTROLS

POWER SWITCH

Although the MO30A incorporates a Power ON-OFF switch, it is advantageous to control the unit from the preamplifier. In this way the MO30A will be switched on and off together with the preamplifier, thereby simplifying operation. The power cord of the MO30A should therefore be inserted into the controlled Auxiliary Power receptacle of the preamplifier, which is controlled by the ON-OFF switch on the preamplifier.

If the MO30A cannot be controlled from the preamplifier unit, then the Power switch on the MO30A should be used to turn it ON and OFF.

VOLUME CONTROL

The volume control, a screwdriver adjustment located on the rear panel of the MO30A, is used to compensate for a great variation in preamplifier output levels. Thus, if the preamplifier output is very high, the user will find it is necessary to operate the preamplifier's volume control near minimum to prevent "blasting" volume output from the speaker system. Conversely, if the preamplifier output is low, the preamplifier's volume control may have to be operated near maximum to achieve sufficient volume.

The volume control thus permits the user to adjust the gain of the MO30A so that the preamplifier's volume control is operated in its mid-range to achieve the desired volume level range.

SPEECH-MUSIC SWITCH

The SPEECH-MUSIC switch, located on top of the chassis (see figure 5), is used to provide optimum response for speech when placed in SPEECH position.

INPUT TERMINAL SWITCH

The Input Terminal switch, located on top of the chassis, is used for switching between high impedance and low impedance inputs on the input terminals. When low impedance input is desired, the proper impedance matching transformer (TL600 or TL10K) should be plugged into socket XI and the switch placed in LO Z position.

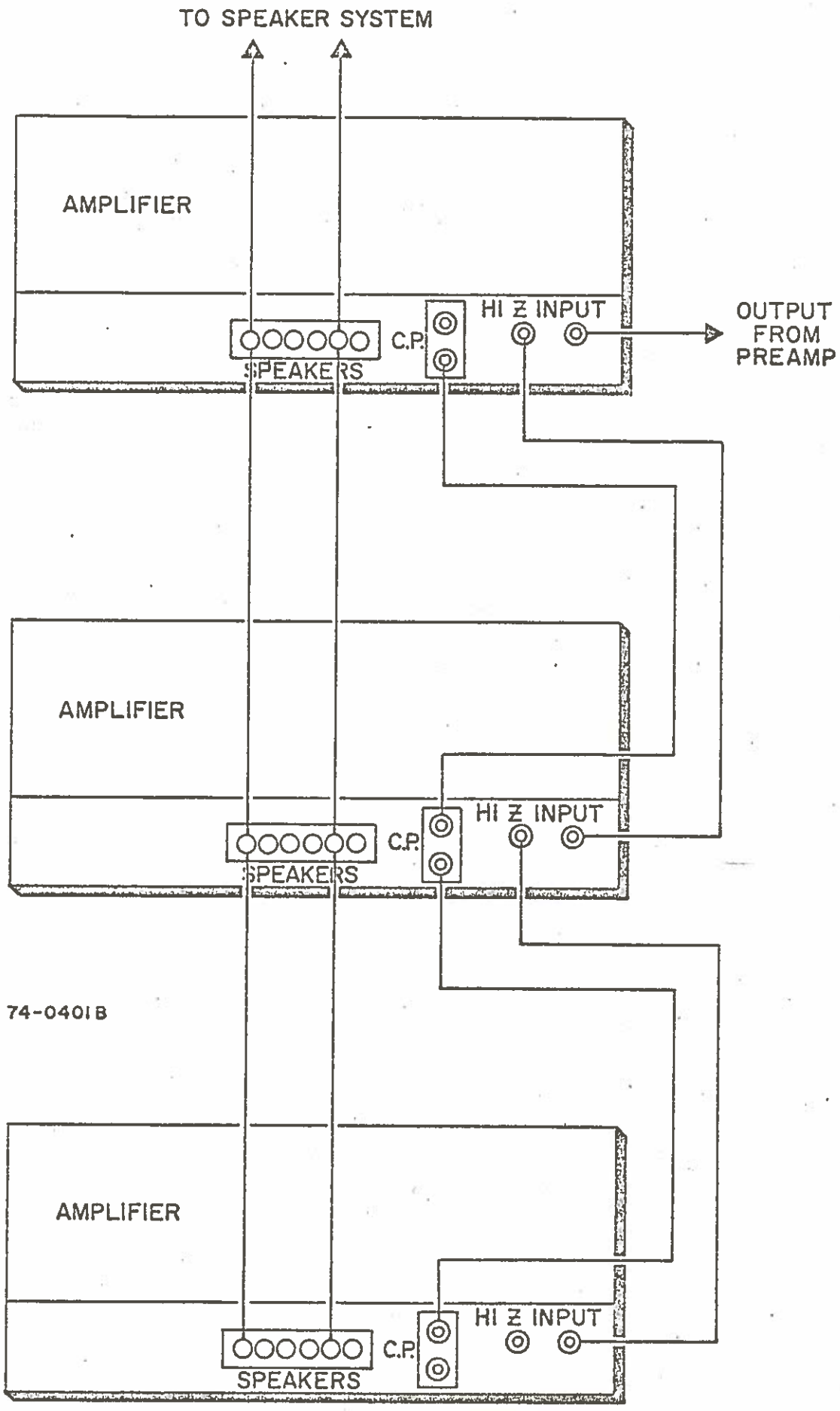


Figure 4 – Paralleling Amplifiers

CAUTION – READ CAREFULLY

1. The high output and sensitivity of the model MXM-A preamplifier makes it possible to parallel up to three units with the MO30A booster, to provide a total of 15 available microphone inputs. It is important, therefore, that the overall system gain be properly adjusted when only one MXM-A preamp is used to drive the MO30A amplifier. Adjust the Volume control on the booster amplifier to provide a high-impedance booster sensitivity of 20 volts for full output or a sensitivity of about 4 volts for a 500/600 ohm input. This is accomplished by turning the Volume control approximately one-quarter turn clockwise from the off position and setting the Master Gain control on the MXM-A to about "6" position. When the amplifier and preamp level controls have been adjusted as described above, all input channels will have more than sufficient sensitivity. In addition, these settings will eliminate unnecessary and excessive system gain, hum, noise and possible oscillation.

2. When paralleling amplifiers be certain that SPEECH-MUSIC switch on the top of the amplifier chassis is in the same position on all amplifiers. Rotate VOLUME control fully clockwise on all amplifiers. If it is desired to reduce the volume, each amplifier's VOLUME control should be set so that exactly equal gains are achieved for each amplifier. Preferably a common resistance loss circuit should be installed to achieve best results.

3. Do not connect a phonograph to the AC receptacle on top of the amplifier chassis, as this may cause flats to appear on the phono idler wheel. If the amplifier controls the power to the phonograph, there is a danger that the amplifier might be turned off before the phonograph is disengaged, thereby damaging the idler wheel.

MAINTENANCE

BOGEN SERVICE

If trouble ever develops with your unit, please do not hesitate to ask our advice or assistance. We are interested in your Bogen unit for as long as you have it. Information can be obtained by writing to: Service Department, Bogen Communications, P. O. Box 500, Paramus, New Jersey.

When communicating with us give the model number and series number of your unit. Completely describe the difficulty encountered, and the effect each operating control has upon the symptoms of trouble. Include details on electrical connections to associated equipment and list such equipment.

When we receive this information we will send you service information if the trouble appears to be a simple one which can be connected by replacing tubes or changing connections. If trouble requires servicing, we shall send you the name and address of the nearest Bogen authorized service agency to which you can send your unit for repair.

When shipping your unit, pack instrument well using filler material to prevent damage in transit. Send unit, fully insured and prepaid, via railway express. Do not ship via parcel post unless so instructed. The unit will be promptly repaired and returned to you via express collect.

PILOT LIGHT REPLACEMENT

The pilot light is located in a holder behind a jewel on the front panel. To replace bulb, first remove eight self tapping screws holding chassis bottom plate. Press bulb in and rotate counterclockwise slightly. The bulb will then spring free. Use only a #47 bulb for replacement.

FUSE REPLACEMENT

A 1.5 ampere slow-blow fuse is located on the rear of the chassis. To replace fuse, press the spring-loaded cap slightly inward and withdraw cap and fuse. Use only a fuse of the same rating for replacement. If a second fuse blows, do not attempt to operate the equipment further. Consult an experienced technician or Bogen representative for inspection of the unit.

BALANCING OUTPUT TUBES

If any of the two 7868 output tubes are replaced, balance tubes as follows:

1. Connect a dummy load across amplifier output, which is capable of handling full rated power output. In addition connect an AC VTVM and an oscilloscope across dummy load.
2. Feed a 1,000 cycle signal into the HI Z input and adjust signal level to point where clipping occurs. This provides slightly over full rated output of amplifier as measured with AC VTVM.
3. The BALANCE ADJUSTMENT control is located on top of chassis adjacent to output tubes, and is a screwdriver adjustment. Rotate this control to position which provides equal clipping on oscilloscope.

NOTE: *If a distortion analyzer is available, this should be used in preference to oscilloscope. In this case, a distortion reading of approximately 1 percent or less should be measured at full output, provided everything else in amplifier is operating properly.*

For field service, where test equipment is not available, set balance control to approximately center position.

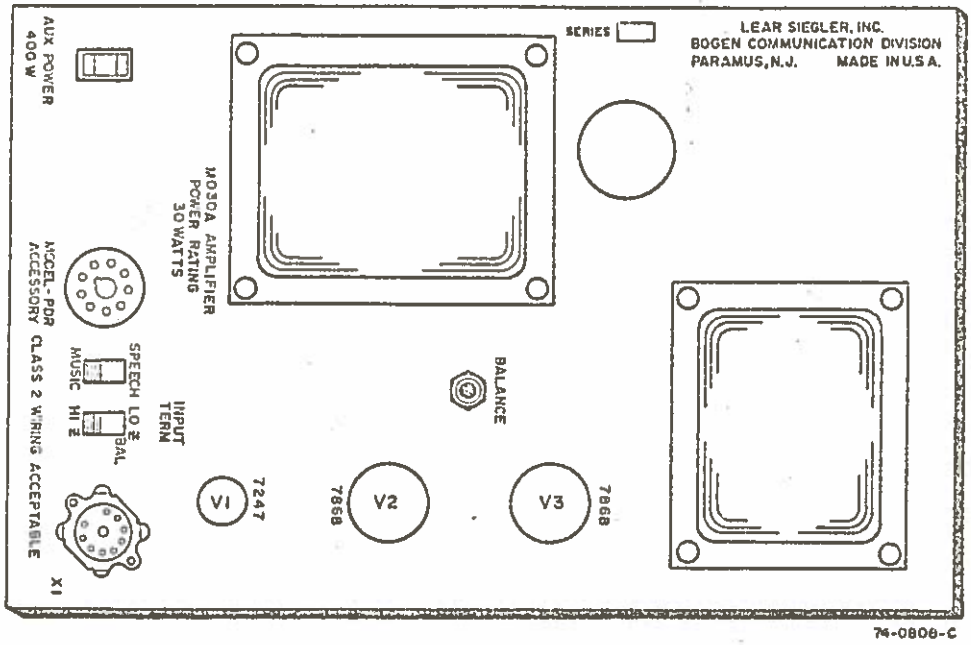


Figure 5 – Top View of Chassis

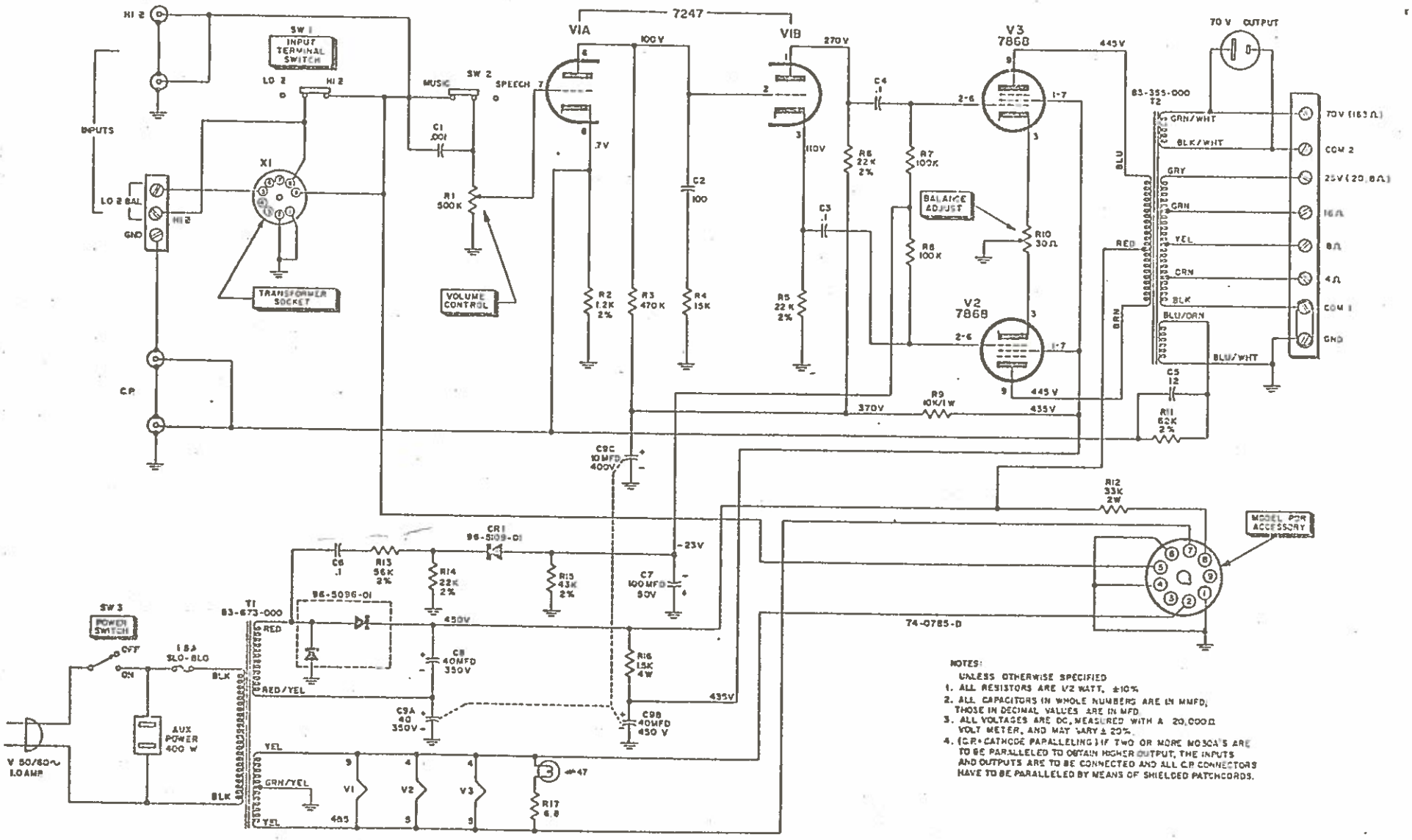
REPLACEMENT PARTS

The components used in the Bogen model MO30A amplifier; with exception of items listed below, are standard parts available through all reputable parts jobbers. However several parts are custom-made to strict Bogen specifications and should be replaced only with genuine Bogen parts. These custom-made parts are listed here and are available through Bogen distributors, service agencies or direct from the factory.

When ordering parts specify part number and description as indicated below, and give the model and series number of the equipment.

Ref. No.	Part No.	Description
C7	79-001-058	Capacitor, Electrolytic, 100 mfd, 50 V
C8	79-001-117	Capacitor, Electrolytic, 40 mfd, 350 V
C9	79-010-051	Capacitor, Electrolytic, 40/350, 40/450, 10/400
CR1	96-5109-01	Diode, Silicon
CR2	96-5096-01	Diodes, Silicon, Doubler
R1	77-001-275	Control, Volume, Screw Driver Adj.
R2	75-235-122	Resistor, 1.2 K, ½ w, 2%
R5	75-235-223	Resistor, 22 K, ½ w, 2%
R6	75-235-223	Resistor, 22 K, ½ w, 2%

Ref. No.	Part No.	Description
R10	77-001-563	Control, Balance, Screw Driver Adj.
R11	75-235-623	Resistor, 62 K, ½ w, 2%
R13	75-235-563	Resistor, 56 K, ½ w, 2%
R14	75-235-223	Resistor, 22 K, ½ w, 2%
R15	75-235-433	Resistor, 43 K, ½ w, 2%
R16	75-552-152	Resistor, 1.5 K, 4 w
R17	75-742-511	Resistor, 6.8 ohms, ½ w, W.W.
SW1	81-003-016	Switch, Input Selector
SW2	81-003-016	Switch, Speech-Music
SW3	81-002-098	Switch, Power
T1	83-673-000	Transformer, Power
T2	83-355-000	Transformer, Output



NOTES:
UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE 1/2 WATT, ±10%
2. ALL CAPACITORS IN WHOLE NUMBERS ARE IN MMFD; THOSE IN DECIMAL VALUES ARE IN MFD.
3. ALL VOLTAGES ARE DC, MEASURED WITH A 20,000Ω VOLT METER, AND MAY VARY ± 20%.
4. (C.P.+CATHODE PARALLELING) IF TWO OR MORE MO30A'S ARE TO BE PARALLELED TO OBTAIN HIGHER OUTPUT, THE INPUTS AND OUTPUTS ARE TO BE CONNECTED AND ALL C.P. CONNECTORS HAVE TO BE PARALLELED BY MEANS OF SHIELDED PATCHCORDS.

Figure 6 – Model MO30A Schematic Diagram

WARRANTY

The Bogen equipment which you have just purchased has been carefully tested and inspected before leaving our factory. When properly installed and operated in accordance with instructions furnished, it should give excellent performance and reliable operation.

Bogen equipment is guaranteed against all defects in material and workmanship for one year from date of sale to the original purchaser. Any part of the equipment which, under normal installation and use, becomes defective will be repaired or replaced by us, provided it is returned for our examination. Transportation prepaid, to our factory (or authorized service station). This warranty does not apply to equipment which has been subjected to abuse or accident, or which has been altered in any way; nor does this warranty extend to tubes, vibrators, or accessories, etc., not of our own manufacture and which are separately covered by the producing manufacturer's warranty.

The registration card enclosed with the equipment must be filled out and mailed to us within 5 days of purchase to place the warranty in effect.